# Reconciling Global Commodity Prices with Financial Markets: a Panel Data Analysis

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**Abstract**

Commodity prices are often correlated with financing conditions in global markets. The Fixed Effects model disentangles the effects of commodity prices and financial indicators on the domestic macro-economy, trade patterns and the supply of credit. Overall, higher prices of energy, metals and minerals weigh on economic growth and consumption. Global liquidity conditions and the VIX exert profound influence on economic growth, whereby the extent varies among the panels. Domestic credit varies with output in this environment. In emerging economies, whilst quantitatively more exposed to those exogenous factors, agricultural commodities become drivers of economic growth and all of the commodity prices affect investment. Separating the economies along the trading of commodities shows that lower energy prices and ampler liquidity are favorable for the trade balance in commodity importing economies, whereas the opposite is indicated for commodity exporters. Larger volatility in the S&P500, on the other side, improves the trade balance for commodity exporters. Finally, the analysis underscores the importance of the US Treasury bond yield for the business cycle, the net trade balance, and credit provision in commodity importing economies.

**JEL Codes:** E32, F41, G15, Q02

**Keywords:** Commodity Prices; Financial Indicators; Business Cycle; Financial Cycle, Fixed Effects; Panel Data.

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## 1 Introduction

Commodity prices often co-move with global financing conditions (Curatola-Melo and Guimaraes, 2026). The Fixed Effect (FE) analysis shows that global financial conditions interact with disaggregated commodity prices. Climbing energy, metals and minerals prices in general put a drag on economic growth. Credit supply turns out to mediate in between the exogenous shocks and the domestic economy. In emerging markets, higher prices for agricultural products spur economic growth and the pass-through of commodity prices to investment is illustrated.

Firms incur costs related to energy and other commodities, especially in energy intensive industries. In commodity exporting Brazil, for example, exogenous commodity prices spill over to industrial production, when combined with variables such as imports, the Sistema Especial de Liquidação e de Custódia (Selic) rate and inflation expectations (Cavalcanti, 2013). The joint analysis of global financial developments and the commodities sector to affect the trade balance and the business cycle may offer insights for commodity exporters, in particular if contrasted with commodity importers.

Isolating the effects of commodity prices from disturbances in financial markets is indicative of whether direct trade links in the commodities sectors or broader conditions in financial markets, which are independent from those trade relations, drive economic activity (Curatola-Melo and Guimaraes, 2026). In this context, it is instructive to examine whether consistent results are obtained for the impact of the isolated, exogenous shocks on the trade balance and on output.

From a broader perspective, the ongoing conflict around the Strait of Hormuz constitutes a negative supply shock within the oil and gas markets that increases inflationary pressures, deteriorates supply chains and worsens growth prospects, while weighing on financial conditions (IMF, 2026*a*). Especially during times of high oil prices, agricultural prices exhibit higher sensitivity to oil price movements, fueling the risk of global food price crises (Fernandez-Perez et al., 2016). Disruptions in global energy markets raises the question for economic policy makers in advanced and emerging economies how commodity price shocks ripple through the domestic economy and affect public finances.

An extensive literature has examined the spill-over of commodity prices for business cycles in emerging economies, documenting the role of financial markets (e.g., Mendoza (1995), Kose (2002), Moreno et al. (2014), Fernández et al. (2017), Fernández et al. (2018), Juvenal and Petrella (2024), Curatola-Melo and Guimaraes (2026)). The panel data analysis relates in content to Fernández et al. (2017), Curatola-Melo and Guimaraes (2026) and Juvenal and Petrella (2024). Fernández et al. (2017) assess the strength of the transmission of commodity price shocks and the world interest rate on the domestic economy through the lens of a Structural Vector Autoregressive model. Curatola-Melo and Guimaraes (2026) use high-frequency (daily) identification and, more specifically, the identification-through-heteroskedasticity approach to analyze USDA Grain Stock reports, that have an exogenous impact on soybean, corn, and wheat prices. Instead of taking commodity price movements as fully ex-

ogenous to emerging market indicators, their causal effects are separated from external factors, which are correlated with commodity prices, such as global growth expectations and financial conditions. Juvenal and Petrella (2024) investigate how commodity prices feed into the co-movement between business cycles and capital flows in emerging and developing economies. The authors employ a panel local projection method with instrumental variables to find that export price disturbances have significant effects on GDP, yet not on capital flows. Moreover, it is assessed whether the easing of global financial conditions induce export price changes in turn caused by commodity price shocks.

In the present empirical study, a distinct composition of financial indicators is evaluated to capture world price shocks and financial markets, providing additional insights into the propagation mechanisms of international financial markets. Kose (2002) and Fernández et al. (2017) use the world real interest rate, defined by the latter as the relative price of goods dated in different periods, to capture the global availability of goods across time and changing incentives to consume, save, and work at the individual-country level. The monetary policy of the United States (US) is considered in the empirical work of Juvenal and Petrella (2024), focusing on the Emerging Market Bond Index spread and the Baa spread. Moreno et al. (2014) take the financial openness index of Chinn and Ito (2008). Curatola-Melo and Guimaraes (2026) include the US indicators of Dollar Index, S&P 500, VIX, breakeven inflation, and interest rate. However, less emphasis has been put on the liquidity channel derived from global liquidity (Klau and Fung, 2006) and the VIX (Cavalcanti, 2013) aside the interest rate in the US, and their joint evaluation. Domestic credit supply is further incorporated to test how these financial conditions pass through to the domestic economy (Moreno et al., 2014). It therefore complements research on the transmission mechanisms operating through various, potentially intersecting, financial markets.

While the analyses are for the majority confined to emerging markets (e.g.,Fernández et al. (2017), Fernández et al. (2018), Juvenal and Petrella (2024), CuratolaGuimaraes2026), or commodity exporters (Bergholt et al., 2019) and importers (Catão and Chang, 2015), the comparison of advanced economies versus emerging markets (Mendoza, 1995; Moreno et al., 2014) is informative to uncover the channels through which world shocks are transmitted to domestic economies. Extending on this, the differentiation of the economies along trading in commodities (Peersman et al., 2021) provides insights into the panel specific transmission of global shocks and is useful in revealing trade-related mechanisms within the spill over of world shocks. Despite that the sample size of 40 economies in total is rather moderate when compared to Fernández et al. (2017); Reinhart et al. (2016); Arezki and Brückner (2012), the sample includes the bulk of large economies worldwide.

The FE analysis is agnostic about any theoretical relationship and empirically tests various model specifications. The estimator permits any correlation in between the unobserved heterogeneity and the error term, that arises out of country level specifics within each panel. Cluster-robust inference is obtained allowing for serial correlation in the error term. By circumventing the potentially substantial

cross-sectional omitted variables bias, the within-country approach also makes the results more readily comparable to macro models which study one economy (Arezki and Brückner, 2012).

The empirical findings of the FE panel data analysis are summarized in sequence.

After controlling for international financial markets, all groups share in qualitative terms that higher prices for energy, metals and minerals weigh on economic growth and consumption. Global financial conditions are significant determinants of economic growth: output gains steam when more liquidity is injected globally and output drops with higher volatility in US stock markets as proxied by the VIX. Private and public consumption are broadly aligned with GDP.

The variation in domestic credit is consistent with business cycle dynamics, growing with more accommodative financing conditions and falling with an uptick in the VIX. This result indicates that credit supply is pivotal for the transmission of international financing conditions and commodity prices towards the domestic economy.

Throughout the panels, a meaningful relation in between the real, effective exchange rate (REER) and the trade balance cannot be deduced.

Substantial differences regard the importance of agricultural commodities for GDP in emerging markets in comparison to advanced economies. Moreover, all three commodity prices become relevant for investment into physical capital. It can also be observed that the emerging economies are overall more exposed to international commodity and financial markets in quantitative terms.

When contrasting commodity exporters with commodity importers, climbing energy prices deteriorate the trade balance for importers and are either insignificant for, or improve, the trade balance for exporters. The analysis reveals the key role of the US bond yield for the business cycle, the net trade balance, and credit provision in importing economies, whereas the statistical evidence fades away in exporting economies (except for consumption and credit). The causal effects of global liquidity on the trade balance are diametrically opposed: more liquidity improves the trade balance in importing economies, contrary to the worsening trade balance in exporting economies. Lastly, larger volatility in the S&P500 leads to growing exports over imports in commodity exporting countries, which is not observed for commodity importers.

The share of predicted output fluctuations explained, as measured by overall $R^2$ in the FE estimation, amounts to 8.58% for emerging markets and to 20.7% for commodity exporters.

The remainder of the paper is organized as follows. Section 2 reviews the related literature. Section 3 describes the data, section 4 elaborates on the methodology, section 5 presents the results, before section 6 concludes.

## 2 Literature Review

The following strains of literature assess the impact of commodity prices on the macroeconomy from different angles: firstly, the focus lies on the trade balance and the terms-of-trade from the perspective of a small open economy. Secondly, econometric analysis incorporates various measures of financial conditions on a broader scale. Finally, the correlation and contagion effects in between the commodities are investigated. The aim is to situate the paper within the existing empirical literature and to clarify how it complements previous findings.

Within general equilibrium modeling, the role of terms-of-trade shocks for business cycles can be traced back to the three-sector, small open economy model of Mendoza (1995). Terms-of-trade shocks are procyclical to actual GDP and the real exchange rate, accounting for nearly 1/2 of the variability. The correlation of the terms-of-trade with the net export share is positive, yet negligible of extent. In the small open economy studied by Kose (2002), world price shocks connected to the prices of capital, intermediate and primary goods, and the world real interest rate, explain roughly 88 percent of aggregate output and 90 percent of investment fluctuations. In Alberola and Benigno (2017), productivity differentials exists in between the sectors of tradables, non-tradables and commodities, with the specific focus on labor movements. In the case of international financial mobility, a commodity price boom and the acquisition of net foreign assets comes at the cost of reducing the traded sector along the wealth effect. Catão and Chang (2015) study the effects of world food prices on the macroeconomy and optimal monetary policy from the perspective of a net food importer. Key for the analysis is that the real exchange rate and the terms of trade can move in opposite directions, while the degree of international financial integration varies. Bergholt et al. (2019) find for an oil exporting economy that both international oil price and investment shocks induce macroeconomic co-movements, although the impact of the latter is less pronounced. The conventional trade channel is of less importance for the oil exporter in comparison to the oil importer. Fernández et al. (2018) document that consumption and investment move procyclically with commodity prices, while the real exchange rate and the trade balance move countercyclically. The model features a latent factor, that determines the country specific commodity price in relation with a loading factor which accounts for the strong comovement of commodity prices among emerging market economies.

The present Panel data analysis complements the theory-based analysis by an empirical approach to disentangle and quantify the effects of commodity prices in combination with international financial markets. It encompasses both emerging and advanced economies, and differentiates further in between commodity exporters and importers.

In the econometric, long term analysis of Reinhart et al. (2016), the term of a "Double Bonanza Bust" describes the coincidence of the busts of capital and real commodity prices. The results indicate that the onset of sovereign debt defaults is more probable when capital flows peak in the boom phase and during the sequential years. In the distinct grouping of Arezki and Brückner (2012),

windfalls profits from commodity price booms induce countries to accumulate foreign assets, only if the countries are ethnically homogeneous. Vice versa, in highly ethnically polarized countries, net foreign assets were significantly reduced amid increases in government consumption expenditures and political corruption. Fernández et al. (2017) conclude that world shocks, under which disturbances to the world interest rate are subsumed, explain on average 33% of output fluctuations in individual economies. With the process of innovation in financial markets, termed financialization of commodity markets, evolving post 2000, the figure of business cycle fluctuation doubles. The inspection of Latin American economies in Curatola-Melo and Guimaraes (2026) suggests that the impact of external factors such as global growth expectations and financial conditions is sizable, channeling through via global equilibrium adjustments rather than via the trade balance. Moreno et al. (2014) integrate financial stability concerns for commodity exporters by credit growth to conclude that the correlation between commodity shocks and output growth is higher when countries experience very rapid credit growth during the boom phase.

The analyses are based on advanced methods for the identification of the impact of commodity prices on economic performance. However, evidence on the joint interaction of commodity prices with domestic credit supply and trade, while controlling for global liquidity and risk indicators remains limited. Also, the FE model solves the omitted variables problem and clustering at the country level permits inference that is robust to cross-sectional heteroskedasticity and serial correlation in the error term.

Related to the abovementioned studies, correlation in between prices of energy, agriculture, plus metal and minerals raises the question whether comparable results are obtained when switching one exogenous shock for another. The positive comovement of the cyclical components of real prices of fuel, metals, and agricultural commodities is illustrated by Fernández et al. (2017) and Fernández et al. (2018). Hassler and Sinn (2016) elaborate on the substitutability of the agricultural product of corn used in food production and fossil fuel as a form of energy. In the frictionless economy, the oil price moves towards the food price due to the intensifying scarcity of the exhaustible stock of fossil carbon. Peersman et al. (2021) find that the financialization of commodity markets, and likely informational frictions regarding the global economy, raised spillover effects of oil and food prices. Contagion in prices built up in both directions since the early 2000s and culminated in the price spike of 2008. The one-directional effect of crude oil on agricultural commodities is obtained by Fernandez-Perez et al. (2016). The statistical evidence on the positive impact of agricultural prices on oil, on the other hand, is not clear: a shock to grain prices exerts a small, positive effect on oil prices in Curatola-Melo and Guimaraes (2026), but Fernandez-Perez et al. (2016) do not find that causation.

The commodities are henceforth split into energy, agriculture, as well as minerals and metals (Fernández et al., 2017), whereby any correlation is permitted. At the same time, the share of the

commodities in the export composition can differ substantially.[1] By using disaggregated data on commodities, similarities in between the channels of commodities are derived, and more nuanced findings for the response of the trade balance are received.

## 3 Data

The outcome variable is either output as measured by the Gross Domestic Product (GDP), private consumption, public consumption, investment, the trade-balance-to-GDP ratio or the REER. Investment defines gross fixed capital formation. Thus, the response variables represent business cycle aggregates (Fernández et al., 2017), extended by trade variables and financing via credit. The external trade balance is computed by subtracting the imports of goods and services from the exports of goods and services. The REER is calculated as the geometric weighted average of a basket of bilateral exchange rates, adjusted by the respective relative consumer prices. It can be interpreted as a measure of international competitiveness and gauge of the transmission of external shocks (Klau and Fung, 2006). An increase in the index corresponds to an appreciation. The broad range includes 61 countries.

The explanatory variables can be grouped into two categories: First, exogenous commodity prices of energy, agriculture, and metals and minerals. Second, international financial markets are represented by the 3-months US Treasury bond yield, the global liquidity indicator, and the VIX (Cavalcanti, 2013). The measure of volatility in the US stock market index S&P 500 through the CBOE Volatility Index is given in index points. The global liquidity indicator sums up the lending of banks to all sectors, cross-border and local in foreign currency, and converted into US Dollar as the unit of measure. It is not confined to credit, loans and debt securities, but rather comprises all instruments.

The macroeconomic aggregates are deprived of inflation by the respective Consumer Price Index (CPI) measure. The foreign block, denominated in US Dollar, is deflated by the US CPI measure. The US bond yield is transformed to the gross real interest rate.[2] All variables except the trade-balance-to-output ratio are expressed in (natural) logarithms. The seasonality is removed from the log series of GDP, investment, private and public consumption, as well as the trade-balance-to-output ratio, by computing the moving averages over four quarters.

All data are collected from institutional sources, namely the Bank for International Settlements (BIS), the World Bank, the Organization for Economic Cooperation and Development (OECD), the International Monetary Fund (IMF) and the Federal Reserve Bank of St. Louis (FRED).[3]

[1] Brazil is a large exporter of grain, mainly soybeans and corn, such that the net exports of agricultural products surpass those related to metals and energy. Overall exports of agriculture products roughly equal those of metals and energy. However, imports of petroleum, coal, and metals are non-negligible for Brazil, shifting the trade balance (Curatola-Melo and Guimaraes, 2026).

[2] Consistent with quarterly frequency, the data for the 3-months US Treasury Bill Rate, the VIX, and commodity prices are the respective end of quarter.

[3] The Supplementary Appendix contains a detailed description of the data series and the corresponding sources in section A.

The panels are unbalanced in face of data availability. The time dimension of the panels spans from Q1 1994 to Q2 2018 at maximum. As such, the panels cover the period where financialization took place (Fernández et al., 2017), and the economic effects are not diluted through the COVID-19 pandemic and more recent disruptions in energy markets.

The sample is split into advanced and emerging economies, as well as commodity exporters and importers. The assumption for the "within-estimation" is that, albeit grouped together as follows, the variation in economic conditions and characteristics for the countries within each panel is sizable.

Emerging economies and advanced economies are classified according to the IMF World Economic Outlook (IMF, 2026*b*). The prior group comprises Brazil, Chile, Columbia, Hungary, India, Indonesia, Malaysia, Mexico, Poland, Russia, Saudi Arabia, Thailand and Türkiye. Under the latter group, Australia, Austria, Belgium, Canada, Czechia, Denmark, Finland, France, Germany, Greece, Hong Kong SAR, Ireland, Israel, Italy, Japan, Korea, Luxemburg, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland and the United Kingdom are subsumed.[4]

Commodity Exporters and Commodity Importers are classified in line with Arroyo Marioli and Vegh (2026). Commodity exporting countries are Australia, Brazil, Canada, Chile, Columbia, Indonesia, Norway, Russia, Saudi Arabia and South Africa. Commodity importing countries are Austria, Belgium, Czechia, Denmark, Finland, France, Germany, Greece, Hong Kong SAR, Hungary, India, Ireland, Israel, Italy, Japan, Korea, Luxemburg, Malaysia, Mexico, Netherlands, New Zealand, Poland, Portugal, Singapore, Spain, Sweden, Switzerland, Thailand, Türkiye and the United Kingdom.

For the plots in Figure 1, the quarterly data for the business cycle and commodity prices are detrended using the Hodrick-Prescott filter (Fernández et al., 2017) with $\lambda$=1600. The remaining aggregates of domestic credit, the REER and the trade-balance-to-output ratio, and all three financial indicators are detrended consistently (Hodrick, 2020) to facilitate the comparison.

The time series are presented in the Figure 1. The graphics display the dynamics within global commodity and financial markets, domestic business and credit cycles, and the movements of the REER and the trade balance. For the data that varies across the units, the panel averages are computed. The time series in the domestic sphere are pinned down for each of the groups, i.e., advanced economies, emerging economies, commodity exporters and importers. The question is posed whether global commodity prices reflect financial conditions rather than supply and demand adjustments within the respective markets. While similar swings of business and credit cycles are visible at first glimpse, the extent of the dispersion differs across the samples and the trade patterns are distinct. Overall, business and credit cycles vary with commodity prices to a non-negligible extent. The co-movement of international financial markets and commodity prices is less clear, apart from the liquidity spike surrounding the global financial crisis 2007-2009.

[4]The economy of Hong Kong SAR is interpreted as country alike for the time frame of Q3 1998 to Q2 2018 to incorporate it into the analysis.

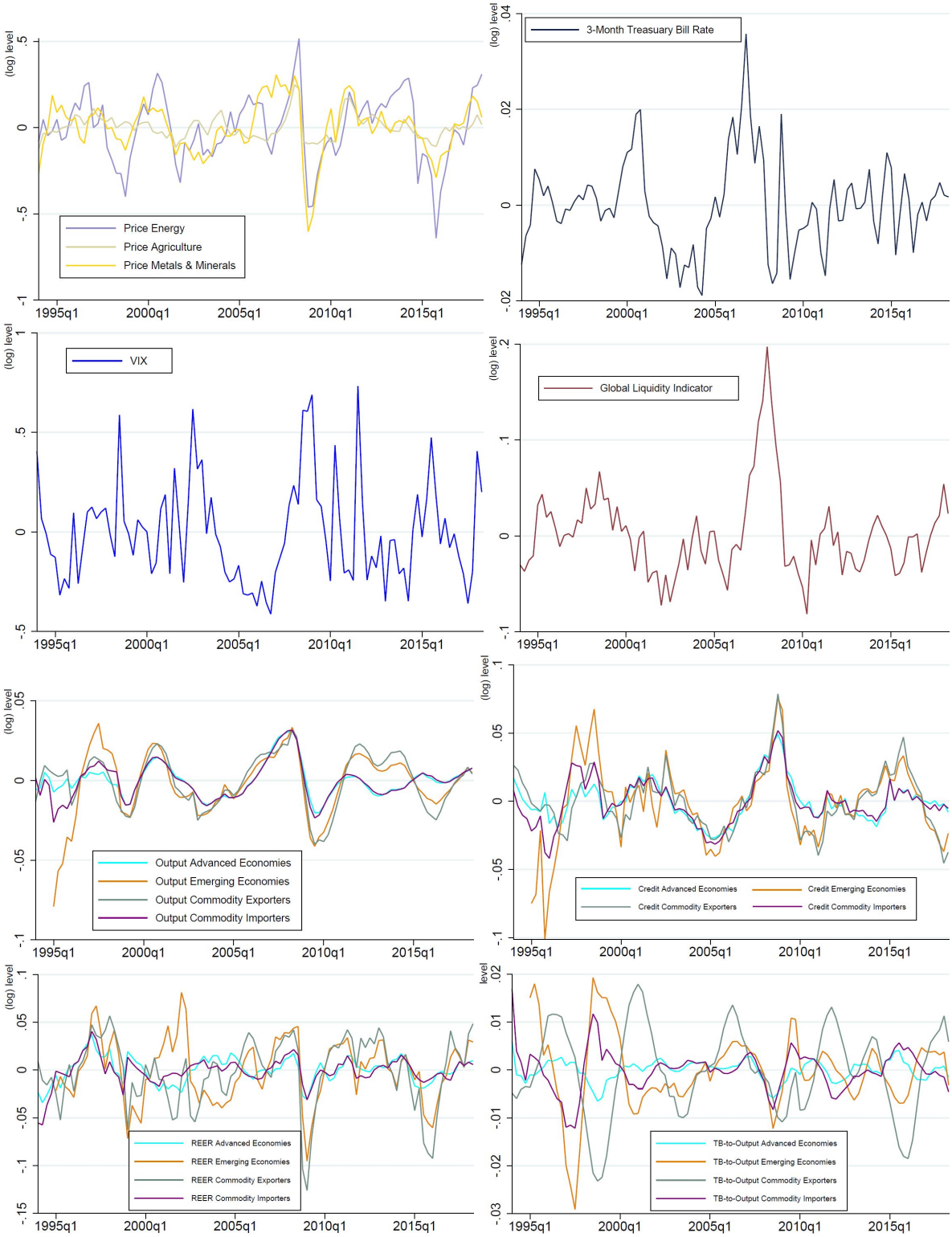


Figure 1: Abbreviations: REER = real, effective exchange rate, TB = trade balance. Commodity prices, the global liquidity indicator, the VIX, the 3-Month treasury bill rate, output, credit, the real, effective exchange rate and the trade-balance-to-output ratio are detrended by the HP filter ($\lambda$=1600). The seasonality is removed from the series of output and the trade-balance-to-output ratio. The 3-Month treasury bill rate is expressed as the gross rate. All variables except the trade balance are given in (natural) logarithms.

A positive degree of correlation might be derived in between the three commodity prices. In between 2007-2009, the dynamics are more synchronized, especially when inspecting the prices of energy on one side, and metals plus minerals on the other side. The global liquidity indicator reveals a sizable injection of liquidity around the time of the subprime mortgage crisis, with the treasury bond yield peaking ahead of liquidity. However, contemporenous commodity prices lack a distinct correlation with global financial conditions, in line with data presented in Juvenal and Petrella (2024). Indication of an leading role of the US treasury bond yield for the supply of domestic credit or a co-movement between the two measures can be hypothesized, whereas the volatility observed for emerging markets and commodity exporters is more pronounced in relative terms.

The swings of the business cycles are on average similar across the country groups after the economic growth rates of the emerging economies pick up speed in the years 1995-1996. Apart from the period 2005-2009, the volatility is nevertheless higher for the emerging economies and commodity exporters. Eyeballing further suggests that business cycles are aligned to a high degree with domestic credit cycles. The swings in global energy prices broadly coincide with business cycles or precede them.

When looking at the detrended trade balance and international price competitiveness, the picture which emerges is not homogeneous.

In sum, the descriptive analysis suggests an interplay of economic performance, domestic credit supply, and global commodity and financial markets. The subsequent empirical analysis explores these mechanisms systematically within a Panel data framework and compares the results across the economy-specific groups.

## 4 Methodology

The empirical study builds upon the linear FE model described in Wooldridge (2001, 2012).[5]

### 4.1 Fixed Effect Model

For each unit $i$, the fixed effects model is formalized as:

$$y_{i,t} = \beta x_{i,t} + c_i + u_{i,t}, t = 1, ..., T \tag{1}$$

where $i$ denotes the individual country, $t$ the time subscript, $x_{i,t}$ the time-varying explanatory variables and $y_{i,t}$ the time-varying outcome variable.

[5]For an application to macro panels and an illustration in Stata, Das (2023) provides additional insights. The statistical software Stata, version 12.0, is used.

The time-constant, unobserved variable $c_i$ defines the unit-specific error term, the fixed effect, that is assumed to be uncorrelated with the error term $u_{i,t}$.

For consistency of the estimator $\beta$, the assumption is made that the conditional mean $E(u_{i,t}|x_{i,t}, c_i) = 0$ for all $t$. This implies strict exogeneity of the explanatory variables with respect to the idiosyncratic errors $E(x'_{i,s}u_{i,t}) = 0, s \neq t$. The central accommodation in the FE model is that $E(c_i|x_{i,t})$ is unrestricted, that is, the explanatory variables might be arbitrarily correlated with the unobserved effects.

Subtracting the time averages from equation (1) removes the time fixed effects :

$$(y_{i,t} - \bar{y}_i) = \beta(x_{i,t} - \bar{x}_i) + (u_{i,t} - \bar{u}_i) \tag{2}$$

where $\bar{y}_i = T^{-1}\sum_{t=1}^{T} y_{i,t}$, $\bar{x}_i = T^{-1}\sum_{t=1}^{T} x_{i,t}$, and $\bar{u}_i = T^{-1}\sum_{t=1}^{T} u_{i,t}$. The consistency condition becomes $E((x_{i,t} - \bar{x}_i)'u_{i,t}) = 0$ under the strict exogeneity of the explanatory variables with respect to the idiosyncratic errors.[6]

In the time-demeaned equation, $(y_{i,t} - \bar{y}_i)$ are the within-country changes of the non-detrended outcome variables. $y_t = (log(gdp_t), log(c_t^{pr}), log(c_t^g), log(inv_t), tb_t/gdp_t, log(REER_t), log(cre_t))$, where $gdp_t$ corresponds to real Gross Domestic Product (GDP), $c_t^{pr}$ to private consumption, $c_t^g$ to public consumption, $inv_t$ to investment, $tb_t/gdp_t$ to the trade-balance-to-output ratio, $REER_t$ to the real, effective, exchange rate, and $cre_t$ to credit. $\beta$ is the fixed effects estimator. Each outcome variable is related to the within-country changes of the exogenous factors $(x_{i,t} - \bar{x}_i)$. $x_t = (log(p_t^f), log(p_t^a), log(p_t^m), log(dtb3_t), log(gli2_t), log(VIX_t))$, where $p_t^f, p_t^a, p_t^m$ denote commodity prices of energy, agriculture, and metals and minerals, respectively. The global financial indicators are represented by the gross 3-months US Treasury bill rate, $dtb3_t$, the global liquidity indicator, $gli2_t$, and the VIX, $VIX_t$.

One could imagine an extension to the model for which the explanatory variables are interacted with selected domestic controls in equations (1) and (2), similar to Arezki and Brückner (2012) and Moreno et al. (2014). In concrete terms, the interactions with the trade balance, the REER, and domestic credit are instructive examples. By intersecting with the fully exogenous variables, merely the effects transmitted through the exogenous shocks are examined, guarding against potential endogeneity. Nevertheless, the FE estimation of the interaction of two time-variant regressors does not yield an unbiased within-estimator and the interpretation of the estimator is blurred (Giesselmann and Schmidt-Catran, 2022). Between-unit variation is transported via the moderator which causes the bias in the estimator through effect heterogeneity across units. Giesselmann and Schmidt-Catran (2022) show that the double demeaning for the interaction term yields the unbiased within-estimator.

[6]The United States of America are not included in the analysis, since endogeneity problems arise for financial conditions. Further, commodity prices cannot be assumed to be exogenous to the dependent variables, because domestic economic conditions in the US might create sufficient demand for a feedback effect on commodity prices. On similar footing, China (apart from Hong Kong SAR) is excluded from the analysis in face of its economic rise over the last decades, aside the lack of available, quarterly data on the national accounts.

This, however, requires that all the variables in the model are demeaned, possibly removing substantial information for FE estimation and reducing the efficiency of the estimator. In the analysis to follow, the exogenous variables are instead regressed on each of the domestic variables. Through the comparison of the impact of international commodity and financial markets on the various macroeconomic variables, conclusions on the channels can be drawn.

Pre-estimation tests constitute the stationarity of the univariate processes and serial correlation in the FE residuals.

As the time series dimension dominates the cross-sectional dimension in the macro panels, time series techniques gain in importance (Das, 2023), and to guard against spurious regression problems in samples, where $N$ is small and $T$ large in relative terms, it is tested whether unit root processes can be rejected for all the variables (Wooldridge, 2012).[7]

In the spirit of (Wooldridge, 2001), the serial correlation in the error term for various model specification is tested along the standard Wooldridge test for autocorrelation in panel data.[8] Because serial correlation is confirmed, clustering at the country level is adopted. The clustering at the country level accounts for serial correlation and heteroskedasticity in the error term and permits cluster-robust inference.

To avoid over-parameterization in an estimation with relatively small $N$ and large $T$, the specific time effects are not included.[9]

# 5 Results

## 5.1 Transmission of Commodity Prices to Output in Aggregate

The comprised effect of commodity prices for output serves as the benchmark, against which to contrast the subsequent analysis that accounts for international financial markets. Despite that the comparison does not present a thorough, causal analysis for the transmission of international financial markets through commodity prices, the changes in the magnitudes and the statistical significance of the effects of commodity prices indicate the role that international financial markets play in it.

[7] The results are attached to the Supplementary Appendix in section B

[8] Section C of the Supplementary Appendix lists those results. The implementation of the test in Stata is facilitated by Drukker (2003).

[9] An equivalent of 97 time dummy variables would be included in the regression for a unit with time series ranging from Q1 1994 to Q2 2018. As noted in section 3, the seasonality that appears in the quarterly time series of the macroeconomic aggregates is removed.

Table 1: **Comprised Effects of Commodity Prices on Output.**
The table presents the results of the Fixed Effects panel data estimation for the groups of advanced economies ($N = 26$), emerging economies ($N = 14$), commodity exporters ($N = 10$) and commodity importers ($N = 30$). Standard errors are clustered at the country level. The constant (not reported) is included in Fixed Effect estimation. p-values are shown in parentheses. The coefficients are rounded to three decimal places. p-values larger than 0.01 are rounded to two decimal places, p-values between 0.001 and 0.01 to three decimal places, p-values smaller than 0.001 are reported as $< 0.001$. *Significantly different from zero at 90% confidence, ** 95% confidence, *** 99% confidence.

| Response/Regressor | $log(p_t^f)$ | $log(p_t^a)$ | $log(p_t^m)$ |
|---|---|---|---|
| $log(gdp_t)$ advanced economies | 0.324*** | 0.081 | -0.037 |
| | (<0.001) | (0.37) | (0.31) |
| $log(gdp_t)$ emerging economies | 0.38* | 0.517* | -0.172** |
| | (0.1) | (0.1) | (0.01) |
| $log(gdp_t)$ commodity exporters | 0.502*** | 0.138 | -0.172* |
| | (0.005) | (0.6) | (0.07) |
| $log(gdp_t)$ commodity importers | 0.285*** | 0.243** | -0.08* |
| | (0.005) | (0.05) | (0.1) |

Table 1 shows that the comprised effects of energy prices on GDP is gauged at roughly 0.3% to 0.5% higher GDP. The estimates of prices in agriculture are positive and significant for emerging markets and commodity importers.[10] Metals and Minerals, meanwhile, display negative and significant coefficients for emerging markets, commodity exporters and importers.

### 5.2 Comparison of Advanced and Emerging Economies

Each of the tables contains seven models, varying with the response variable. It starts with GDP and proceeds with the components of consumption and investment. The net trade-balance is substituted for the REER. The analysis concludes with the impact of the exogenous variables on domestic credit. Thereby, the transmission channels of the commodity and financial prices to the real economy are disentangled for each of the domestic variables. This section compares advanced with emerging economies.

The results for advanced economies are presented next in Table 2. Contrary to the results in Table 1, output is adversely affected by energy prices. Output reacts to changes in all three financial market indicators, primarily channeling through to consumption.

[10]Throughout the analysis, the mark of significance of the coefficients is based on the non-rounded p-values. The p-value for the effect of prices in agriculture on GDP in emerging economies, for example, corresponds to 0.097.

Table 2: **Results Advanced Economies.**
The table presents the results of the Fixed Effects panel data estimation for advanced economies ($N = 26$). Standard errors are clustered at the country level. The constant (not reported) is included in Fixed Effect estimation. p-values are shown in parentheses. The coefficients are rounded to three decimal places. p-values larger than 0.01 are rounded to two decimal places, p-values between 0.001 and 0.01 to three decimal places, p-values smaller than 0.001 are reported as $< 0.001$. *Significantly different from zero at 90% confidence, ** 95% confidence, *** 99% confidence.

| Response/Regressor | $log(p_t^f)$ | $log(p_t^a)$ | $log(p_t^m)$ | $log(dtb3_t)$ | $log(gli2_t)$ | $log(VIX_t)$ |
|---|---|---|---|---|---|---|
| $log(gdp_t)$ | -0.058** | -0.085 | -0.172*** | -0.992*** | 0.624*** | -0.087** |
| | (0.02) | (0.25) | (<0.001) | (<0.001) | (<0.001) | (0.01) |
| $log(c_t^{pr})$ | -0.042** | -0.074 | -0.181*** | -1.21*** | 0.584*** | -0.081*** |
| | (0.02) | (0.28) | (<0.001) | (<0.001) | (<0.001) | (<0.001) |
| $log(c_t^g)$ | -0.071*** | -0.01 | -0.183*** | -1.899*** | 0.637*** | -0.094*** |
| | (0.003) | (0.9) | (<0.001) | (<0.001) | (<0.001) | (<0.001) |
| $log(inv_t)$ | -0.048 | -0.197 | -0.122 | 0.205 | 0.604*** | -0.043 |
| | (0.12) | (0.13) | (0.15) | (0.54) | (<0.001) | (0.28) |
| $tb_t/gdp_t$ | -0.006 | -0.014 | 0.000 | -0.142* | 0.016 | -0.008 |
| | (0.51) | (0.48) | (1) | (0.06) | (0.13) | (0.18) |
| $log(REER_t)$ | 0.028* | -0.044 | 0.041* | -0.346 | -0.006 | 0.008 |
| | (0.08) | (0.36) | (0.07) | (0.12) | (0.81) | (0.56) |
| $log(cre_t)$ | -0.119** | 0.182 | -0.335*** | -1.361*** | 0.957*** | -0.122*** |
| | (0.01) | (0.21) | (<0.001) | (0.001) | (<0.001) | (0.001) |

Climbing global energy prices induce a contractionary effect on output, both private and public consumption, and credit, and an appreciation in the REER. A similar picture appears for the commodities of metals and minerals, whereas agricultural commodities do not reveal statistically significant effects.

The coefficients for global financial markets absorb a substantial part of the effects associated with commodity prices (Table 1). Worsening financial conditions implied by a higher US bond rate reduces output, affecting mainly consumption patterns of both private and public actors. Ampler global liquidity consistently fosters consumption and, in addition, investment. Accordingly, a higher level of the VIX channels through to lower growth rates. International financial conditions are crucial for the credit exposure with theoretically intuitive explanations: the upwards move in financing costs triggered by an increase in the bond yield and a higher degree of volatility in the S&P500 lead to a deleveraging process, whereas a larger injection of liquidity is associated with an accumulation of leverage.

Table 3: **Results Emerging Economies.**
The table presents the results of the Fixed Effects panel data estimation for emerging economies ($N = 14$). Standard errors are clustered at the country level. The constant (typically average of unit-specific constants, not reported here) is included in Fixed Effect estimation. The coefficients are rounded to three decimal places. p-values are shown in parentheses. p-values larger than 0.01 are rounded to two decimal places, p-values between 0.001 and 0.01 to three decimal places, p-values smaller than 0.001 are reported as $< 0.001$. *Significantly different from zero at 90% confidence, ** 95% confidence, *** 99% confidence.

| Response/Regressor | $log(p_t^f)$ | $log(p_t^a)$ | $log(p_t^m)$ | $log(dtb3_t)$ | $log(gli2_t)$ | $log(VIX_t)$ |
|---|---|---|---|---|---|---|
| $log(gdp_t)$ | -0.222*** | 0.356* | -0.562*** | -3.504*** | 1.302*** | -0.339*** |
| | (0.01) | (0.08) | (<0.001) | (0.002) | (<0.001) | (<0.001) |
| $log(c_t^{pr})$ | -0.226** | 0.33 | -0.59*** | -3.704*** | 1.313*** | -0.346*** |
| | (0.01) | (0.14) | (<0.001) | (0.001) | (<0.001) | (<0.001) |
| $log(c_t^g)$ | -0.279*** | 0.41* | -0.603*** | -4.851*** | 1.362*** | -0.365*** |
| | (0.004) | (0.06) | (<0.001) | (<0.001) | (<0.001) | (<0.001) |
| $log(inv_t)$ | -0.223** | 0.651* | -0.685*** | -1.603 | 1.299*** | -0.339*** |
| | (0.02) | (0.06) | (<0.001) | (0.2) | (<0.001) | (0.001) |
| $tb_t/gdp_t$ | 0.002 | -0.073 | 0.046 | -0.27** | 0.006 | 0.007 |
| | (0.92) | (0.29) | (0.11) | (0.02) | (0.75) | (0.68) |
| $log(REER_t)$ | 0.04 | 0.15 | 0.057 | 0.268 | -0.027 | 0.024 |
| | (0.48) | (0.48) | (0.13) | (0.74) | (0.7) | (0.43) |
| $log(cre_t)$ | -0.37** | 0.595 | -0.878*** | -5.307*** | 1.846*** | -0.437*** |
| | (0.01) | (0.13) | (<0.001) | (0.009) | (<0.001) | (<0.001) |

In qualitative terms, the impact of energy prices, metals and minerals, and global financial markets on the business cycle, the net trade balance and credit supply are overall affirmative of the results received for the prior group of countries. A key role of commodities for the net trade balance, as underlying the models of Mendoza (1995), Kose (2002), Alberola and Benigno (2017), cannot be derived for emerging economies.

Yet, several differences appear:

Firstly, the impact increases in absolute terms. A one percentage rise in energy prices leads to a contraction of GDP of about 0.06% in advanced economies compared to 0.22% in emerging markets. The differences in consumption are estimated within a similar range. Financial markets play a larger role inducing sizable changes of GDP and its components in emerging markets: the ceteris paribus effect of the US bond yield on GDP is estimated at -3.5%, the one of global liquidity at 1.3% and the one of the VIX at -0.34%. The distinct impact is also reflected in the variation in output: the $R^2$ of the variation in output for the group of advanced economies is given at a mere 1.24%. This compares against the $R^2$ reaching 8.58% in the panel of emerging markets, which is considerably below the 33% reported in Fernández et al. (2017). Accordingly, the relevance of international financial markets for credit supply gains weight: the spill-over of the US treasury bond is almost four times as large for emerging markets. A 100 basis points change in the 3-months bond yield is associated with a contraction of domestic credit by 5.31%. The positive effect of global liquidity almost doubles to 1.85%. The drop in credit of about 0.12% along a rise in the VIX is gauged at 0.44%, respectively.

Finally, the negative impact of the US treasury bond yield on the net trade balance is more muted for advanced economies at -0.14% against -0.27%.

Secondly, agricultural commodities appear as drivers of economic growth, public consumption and investment in emerging economies, albeit only at the 10% significance level.

Thirdly, private investment into capital in emerging markets is affected by the disaggregated commodity prices, affirmative of Fernández et al. (2018) and different to Juvenal and Petrella (2024). It is reduced in response to higher prices for both energy and metals plus minerals. On the other hand, investment is fueled by higher prices for agricultural products. While the US treasury bond yield is the only determinant of investment detected for the advanced economies, enhanced liquidity and lower VIX are drivers in the emerging economies. A non-negligible amount of correlation might be presumed in between the US bond yield and global liquidity injected by the banking as well as the non-banking system, since US treasuries underlie the pricing of financial products across various asset classes and serve as collateral for credit. Nevertheless, the univariate time series in Figure 1 could reveal a dynamic dependency for the episodes around the Global Financial Crisis and, in reversed order, around 1998-2000, rather than a contemporaneous relation.

Fourthly, a role of energy and metals plus minerals for the REER is only apparent for advanced economies, with an appreciation of 0.03% and 0.04%, respectively. This indicates that advanced economies loose competitiveness when they have to coop with higher prices of energy or metals and minerals.[11]

### 5.3 Comparison of Commodity Exporting and Commodity Importing Economies

Observing similarities for the impact of energy, metals plus minerals, and financial markets across advanced and emerging economies, against the differences for agriculture, gross fixed capital formation and the total impact of the shocks in emerging markets, the following analysis targets commodity exporters and commodity importers. The conjecture is that the net trade-balance and the price competitiveness in the trading sector, adjusted for inflation, are explained in greater detail by the transmission of international commodity and financial markets.

[11] The F-tests at $F(6, 25)$ for the seven models in the latter sample reveal joint significance of the regressors, with the two exceptions marked by the models of the net trade balance and the REER. The p-values are 0.1038 and 0.26, respectively. The test statistics at $F(6, 13)$ for emerging market economies yield the p-value for the terms-of-trade model of 0.0175. For all of the remaining models, the determinants are jointly significant with p-values of 0.0000.

Table 4: **Results Commodity Exporting Economies.**
The table presents the results of the Fixed Effects panel data estimation for commodity exporters ($N = 10$). Standard errors are clustered at the country level. The constant (not reported) is included in Fixed Effect estimation. p-values are shown in parentheses. The coefficients are rounded to three decimal places. p-values larger than 0.01 are rounded to two decimal places, p-values between 0.001 and 0.01 to three decimal places, p-values smaller than 0.001 are reported as $< 0.001$. *Significantly different from zero at 90% confidence, ** 95% confidence, *** 99% confidence.

| Response/Regressor | $log(p_t^f)$ | $log(p_t^a)$ | $log(p_t^m)$ | $log(dtb3_t)$ | $log(gli2_t)$ | $log(VIX_t)$ |
|---|---|---|---|---|---|---|
| $log(gdp_t)$ | -0.192** | 0.513** | -0.52*** | -1.55 | 1.093*** | -0.307*** |
| | (0.04) | (0.04) | (<0.001) | (0.15) | (<0.001) | (0.001) |
| $log(c_t^{pr})$ | -0.262*** | 0.528** | -0.534*** | -1.839* | 1.108*** | -0.324*** |
| | (0.003) | (0.05) | (<0.001) | (0.06) | (<0.001) | (0.001) |
| $log(c_t^g)$ | -0.296*** | 0.612** | -0.558*** | -2.578** | 1.151*** | -0.346*** |
| | (0.003) | (0.02) | (<0.001) | (0.02) | (<0.001) | (<0.001) |
| $log(inv_t)$ | -0.196** | 0.718** | -0.642*** | -0.601 | 1.221*** | -0.303*** |
| | (0.03) | (0.02) | (<0.001) | (0.61) | (<0.001) | (0.001) |
| $tb_t/gdp_t$ | 0.048 | -0.081** | 0.045 | 0.003 | -0.05** | 0.017** |
| | (0.12) | (0.05) | (0.12) | (0.97) | (0.02) | (0.02) |
| $log(REER_t)$ | 0.036 | 0.285 | 0.044 | 0.43 | 0.043 | -0.006 |
| | (0.49) | (0.13) | (0.35) | ( 0.64) | (0.46) | (0.8) |
| $log(cre_t)$ | -0.384*** | 0.754** | -0.781*** | -2.763* | 1.572*** | -0.424*** |
| | (0.004) | (0.05) | (<0.001) | (0.07) | (<0.001) | (0.001) |

Overall $R^2$ reaches 20.7% for the predicted variation in GDP.[12] When decomposing GDP, the negative impact of prices for energy, metals and minerals on investment becomes evident. Higher income raised by agriculture, to the contrary, fuels investment and output. The magnitudes are broadly in the same range for output, consumption and investment (about -0.2% to -0.3% induced by an uptick in energy prices, 0.5% to 0.7% induced by an higher valuation of agricultural commodities, and -0.2% to -0.3% caused by climbing prices within the sector of minerals and metals).

A rise in global liquidity and a reduction in the VIX spurs economic growth, as revealed by the changes of consumption and investment. Again, the profound impact of international commodity and financial markets on domestic credit is enforced and the synchronization with the business cycle is documented. The relevance of the liquidity channel is reflected in about 1.6% credit growth, ceteris paribus.

The results for the net trade balance and the REER are rather diverse. On theoretical grounds, the assumption is made that an improvement in competitiveness marked by a lower REER is related to a rise in exports over imports, i.e., an improvement in the trade balance. Nevertheless, this relation is not displayed for commodity exporters: on one side, the REER is not altered by the regressors at the conventional significance levels. On the other side, rising agricultural prices deteriorate the trade balance and the coefficients for energy and metals and minerals are estimated close to 10% percent significance with positive signs. Furthermore, the trade balance deteriorates with a higher level of liquidity and is more favorable with an upwards movement of the VIX.

[12] For all specifications, the joint significance test at $F(6, 9)$ results in p-values below the the 1% threshold.

Table 5: **Results Commodity Importing Economies.**
The table presents the results of the Fixed Effects panel data estimation for commodity importers ($N = 30$). Standard errors are clustered at the country level. The constant (not reported) is included in Fixed Effect estimation. p-values are shown in parentheses. The coefficients are rounded to three decimal places. p-values larger than 0.01 are rounded to two decimal places, p-values between 0.001 and 0.01 to three decimal places, p-values smaller than 0.001 are reported as $< 0.001$. *Significantly different from zero at 90% confidence, ** 95% confidence, *** 99% confidence.

| Response/Regressor | $log(p_t^f)$ | $log(p_t^a)$ | $log(p_t^m)$ | $log(dtb3_t)$ | $log(gli2_t)$ | $log(VIX_t)$ |
|---|---|---|---|---|---|---|
| $log(gdp_t)$ | -0.091** | -0.042 | -0.23*** | -1.73*** | 0.696*** | -0.12*** |
| | (0.01) | (0.7) | (<0.001) | (<0.001) | (<0.001) | (<0.001) |
| $log(c_t^{pr})$ | -0.057 | -0.048 | 0-.245*** | -1.942*** | 0.657*** | -0.112*** |
| | (0.11) | (0.66) | (<0.001) | (<0.001) | (<0.001) | (<0.001) |
| $log(c_t^g)$ | -0.093** | 0.014 | -0.245*** | -2.77*** | 0.714*** | -0.126*** |
| | (0.02) | (0.9) | (<0.001) | (<0.001) | (<0.001) | (<0.001) |
| $log(inv_t)$ | -0.087** | -0.055 | -0.205** | -0.185 | 0.643*** | -0.083* |
| | (0.03) | (0.73) | (0.02) | (0.67) | (<0.001) | (0.08) |
| $tb_t/gdp_t$ | -0.017** | -0.027 | 0.007 | -0.227*** | 0.029*** | -0.008 |
| | (0.02) | (0.34) | (0.6) | (0.003) | (0.003) | (0.28) |
| $log(REER_t)$ | 0.029 | -0.057 | 0.045** | -0.311 | -0.019 | 0.018 |
| | (0.13) | (0.36) | (0.03) | (0.16) | (0.52) | (0.21) |
| $log(cre_t)$ | -0.152** | 0.235 | -0.425*** | -2.368*** | 1.055*** | -0.158*** |
| | (0.02) | (0.26) | (<0.001) | (0.004) | (<0.001) | (0.001) |

The results for commodity importers in Table 5 are largely congruent regarding the business cycle and credit, although the effects are more muted in magnitude. In comparison, agricultural prices are not detected as a significant drivers of business cycles in importing economies whilst the US bond yield becomes relevant for output and consumption. Overall $R^2$ for predicted output variation amounts to 1.4%.[13]

The distinct variations in trade for commodity exporters and importers are intuitive: rising energy costs induce a deterioration of the trade balance for importers whilst they are insignificant or improving the trade balance for exporters, if indicated at the p-value of 0.12. Applied to oil markets in absolute terms, this result aligns with the finding of Peersman et al. (2021) that the conventional trade channel is less important for the oil exporter than for the oil importer. A financial shock triggered by a higher interest rate in the US worsens the balance of exports versus imports. Further, the relation to global liquidity is turned upside down, reiterating the relevance of the liquidity channel globally: while a higher level of liquidity steers exports in importing economies, it induces an accumulation of imports in exporting economies. Like for the commodity exporters, a statistically evident relation in between the net trade balance and the REER cannot be deduced. Prices for metals and minerals lead to an appreciation in the REER, equal to loosing international competitiveness, against the backdrop of no evident effect on the trade balance in exporting economies.

[13]The p-values for the F(6,29) statistics are all significant at the 1% level except for the REER (p-value of 0.1234).

## 6 Conclusions

The FE analysis examines how exogenous commodity price shocks propagate through the domestic economy, when international financial markets in form of the US Treasury bond yield, global supply of liquidity, and the VIX are factored in. The key findings underscore the relevance of the US financial markets including the policy of the Federal Reserve, given that the interest rate is associated with monetary policy (Taylor, 1993), and the internationally leading role of the US Dollar (Prasad, 2016).

The opposite signs obtained for energy and agriculture with respect to GDP can be further explored in the panels of emerging markets and commodity exporters, expanding on the sample size, using more granular data on the commodities, and disclosing the channels of transmission within these two commodities. Accordingly, it is observed that government spending moves procyclically with agriculture and countercyclically with energy and metals plus minerals.

The consistent and wide-spread relevance of the exogenous factors for real credit, that mimics the business cycle in this environment, calls for a closer inspection. The connection of the credit cycle with the commodity price cycle, for instance regarding the fiscal stance (Alberola and Sousa, 2017), is left for further research.

Another strain of research might focus on the disconnect in between international shocks and competitiveness as proxied by the REER on one side and the net trade balance on the other side, if international commodity and financial markets are accounted for.

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# A Supplementary Appendix: Description and Sources of Data

Table A.1: **Description and Sources of Data, Foreign Block**
The table lists the description and the corresponding source of data for the foreign block. Abbreviations: Bank for International Settlements (BIS), International Financial Statistics (IFS), International Monetary Fund (IMF), Federal Reserve Bank of St. Louis (FRED). Note: The symbol accounts for transformation into real variables except for the VIX (in index points).

| Description | Symbol | Source |
|---|---|---|
| Commodity Prices Energy, monthly indices, based on nominal US dollars (2010=100) | $p_t^f$ | World Bank Commodities Price Data |
| Commodity Prices Agriculture, monthly indices, based on nominal US dollars (2010=100) | $p_t^a$ | World Bank Commodities Price Data |
| Commodity Prices Metals & Minerals, monthly indices, based on nominal US dollars (2010=100) | $p_t^m$ | World Bank Commodities Price Data |
| Consumer Price Index, USA, index, basis 2010, all items, percentage change, previous period, percent, quarterly | | IFS, IMF |
| 3-Month Treasury Bill, secondary market rate, percent, daily, not seasonally adjusted | $dtb3_t$ | FRED |
| CBOE Volatility Index, VIX, index, not seasonally adjusted, end of quarter | $VIX_t$ | FRED |
| Global liquidity indicator, all currencies, all countries, all sectors, banks, total, cross-border & local in FCY, all instruments, US dollar | $gli2_t$ | BIS |

Table A.2: **Description and Sources of Data, Domestic Block**
The table lists the description and the corresponding source of data for the domestic block. Sample: Australia, Austria, Belgium, Brazil, Canada, Chile, Columbia, Czechia, Denmark, Finland, France, Germany, Greece, Hong Kong SAR, Hungary, India, Indonesia, Ireland, Israel, Italy, Japan, Korea, Luxemburg, Malaysia, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Russia, Saudi Arabia, Singapore, Spain, Sweden, Switzerland, Thailand, Türkiye, United Kingdom. Abbreviations: Bank for International Settlements (BIS), Organization for Economic Cooperation and Development (OECD), International Financial Statistics (IFS), International Monetary Fund (IMF). The symbol accounts for transformation into real variables. Note: *The data for Hong Kong SAR, Malaysia, Singapore and Thailand is collected from IFS, IMF.

| Description | Symbol | Source |
|---|---|---|
| Consumer Price Index, all items, percentage change, previous period, percent, quarterly | | IFS, IMF |
| Gross domestic product - expenditure approach, national currency, current prices, quarterly levels | $gdp_t$ | Quarterly National Accounts, OECD / IFS, IMF* |
| Private final consumption expenditure, national currency, current prices, quarterly levels | $c_t^{pr}$ | Quarterly National Accounts, OECD / IFS, IMF* |
| General government final consumption expenditure, national currency, current prices, quarterly levels | $c_t^g$ | Quarterly National Accounts, OECD / IFS, IMF* |
| Gross fixed capital formation, national currency, current prices, quarterly levels | $inv_t$ | Quarterly National Accounts, OECD / IFS, IMF* |
| External balance of goods and services, national currency, current prices, quarterly levels | $tb_t$ | Quarterly National Accounts, OECD / IFS, IMF* |
| Effective exchange rates, broad (61 countries), real | $REER_t$ | BIS |
| Credit to the non-financial sector | $cre_t$ | BIS |

# B Supplementary Appendix: Results of the Unit Root Testing

The tests are conducted on the log transformed data (except for the trade-balance-to-output ratio). The seasonality is removed from the business cycle variables of output, private and public consumption, investment and the trade-balance-to-output ratio. The Fisher-type unit root tests (Fisher, 1932) for panel data uses the p-values of the statistics out of unit-specific Augmented Dickey Fuller (ADF) regressions (Choi, 2001). The Fisher test runs on unbalanced panels without gaps within each panel and assumes cross-section independence. Cross-sectional means are removed. Aside the specification of 2 lags, the drift option is included in each of the ADF regressions to account for a potential trend (Das, 2023) and for non-zero means of the processes for each of the units. Due to the size of the panels, with $N$ not large, the inverse normal $Z$ statistic and the inverse $\chi^2$ P statistic are reported. For all the response variables, the Null hypothesis of unit roots in all panels is rejected. The stationarity of the exogenous shocks is examined using the ADF test (Dickey and Fuller, 1979) with 2 lags and drift.

## B.1 Results of the Fisher-type Panel Unit Root test

Table B.1: **Results of the Fisher-type Panel Unit Root test, Advanced Economies.**
The table presents the results of the Fisher-type panel unit root test developed by Choi (2001). The Null hypothesis assumes that all panels contain unit roots. The variables represent the domestic block of advanced economies. $N = 26$. p-values are shown in parentheses. p-values larger than 0.01 are rounded to two decimal places, p-values between 0.001 and 0.01 to three decimal places, p-values smaller than 0.001 are reported as $< 0.001$. *Significantly different from zero at 90% confidence, ** 95% confidence, *** 99% confidence.

| Response | $log(gdp_t)$ | $log(c_t^{pr})$ | $log(c_t^g)$ | $log(inv_t)$ | $tb_t/gdp_t$ | $log(REER_t)$ | $log(cre_t)$ |
|---|---|---|---|---|---|---|---|
| Inv. $\chi^2(52)$ P | 196.7697*** | 250.2304*** | 266.1995*** | 217.1705*** | 207.9405*** | 176.6775*** | 215.4627*** |
| | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) |
| Inv. normal Z | -8.1338*** | -9.9128*** | -10.8860*** | -9.7329*** | -10.0075*** | -9.1039*** | -8.6023*** |
| | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) |

Table B.2: **Results of the Fisher-type Panel Unit Root test, Emerging Economies.**
The table presents the results of the Fisher-type panel unit root test developed by Choi (2001). The Null hypothesis assumes that all panels contain unit roots. The variables represent the domestic block of emerging economies. $N = 14$. p-values are shown in parentheses. p-values larger than 0.01 are rounded to two decimal places, p-values between 0.001 and 0.01 to three decimal places, p-values smaller than 0.001 are reported as $< 0.001$. *Significantly different from zero at 90% confidence, ** 95% confidence, *** 99% confidence.

| Response | $log(gdp_t)$ | $log(c_t^{pr})$ | $log(c_t^g)$ | $log(inv_t)$ | $tb_t/gdp_t$ | $log(REER_t)$ | $log(cre_t)$ |
|---|---|---|---|---|---|---|---|
| Inv. $\chi^2(28)$ P | 114.3500*** | 103.8501*** | 118.4546*** | 110.7872*** | 104.5751*** | 88.8938*** | 87.1103*** |
| | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) |
| Inv. normal Z | -6.0215*** | -5.3530*** | -6.3507*** | -6.3728*** | -7.1540*** | -6.1934*** | -5.2757*** |
| | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) |

Table B.3: **Results of the Fisher-type Panel Unit Root test, Commodity Exporters.**
The table presents the results of the Fisher-type panel unit root test developed by Choi (2001). The Null hypothesis assumes that all panels contain unit roots. The variables represent the domestic block of commodity exporting economies. $N = 10$. p-values are shown in parentheses. p-values larger than 0.01 are rounded to two decimal places, p-values between 0.001 and 0.01 to three decimal places, p-values smaller than 0.001 are reported as $< 0.001$. *Significantly different from zero at 90% confidence, ** 95% confidence, *** 99% confidence.

| Response | $log(gdp_t)$ | $log(c_t^{pr})$ | $log(c_t^g)$ | $log(inv_t)$ | $tb_t/gdp_t$ | $log(REER_t)$ | $log(cre_t)$ |
|---|---|---|---|---|---|---|---|
| Inv. $\chi^2(20)$ P | 54.1451*** | 60.5480*** | 56.7981*** | 50.8951*** | 84.3338*** | 66.8976*** | 52.0192*** |
| | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) |
| Inv. normal Z | -4.6048*** | -5.0895*** | -4.8368*** | -4.2547*** | -6.6213*** | -5.6176*** | -4.3272*** |
| | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) |

Table B.4: **Results of the Fisher-type Panel Unit Root test, Commodity Importers.**
The table presents the results of the Fisher-type panel unit root test developed by Choi (2001). The Null hypothesis assumes that all panels contain unit roots. The variables represent the domestic block of commodity importing economies. $N = 30$. p-values are shown in parentheses. p-values larger than 0.01 are rounded to two decimal places, p-values between 0.001 and 0.01 to three decimal places, p-values smaller than 0.001 are reported as $< 0.001$. *Significantly different from zero at 90% confidence, ** 95% confidence, *** 99% confidence.

| Response | $log(gdp_t)$ | $log(c_t^{pr})$ | $log(c_t^g)$ | $log(inv_t)$ | $tb_t/gdp_t$ | $log(REER_t)$ | $log(cre_t)$ |
|---|---|---|---|---|---|---|---|
| Inv. $\chi^2(60)$ P | 249.6012*** | 275.5675*** | 285.7824*** | 273.8554*** | 240.3318*** | 220.3074*** | 200.0673*** |
| | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) |
| Inv. normal Z | -9.3506*** | -9.9146*** | -11.1457*** | -10.9911*** | -10.8355*** | -10.1993*** | -6.6416*** |
| | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) |

Table B.5: **Results of the Augmented Dickey Fuller test, Exogenous Variables**
The table presents the results of the Augmented Dickey Fuller test for unit root (Dickey and Fuller, 1979). The Null hypothesis assumes the unit root. The constant is included. The variables represent the foreign block. p-values are shown in parentheses. p-values larger than 0.01 are rounded to two decimal places, p-values between 0.001 and 0.01 to three decimal places, p-values smaller than 0.001 are reported as $< 0.001$. *Significantly different from zero at 90% confidence, ** 95% confidence, *** 99% confidence.

| Variable | $log(p_t^f)$ | $log(p_t^a)$ | $log(p_t^m)$ | $log(dtb3_t)$ | $log(gli2_t)$ | $log(VIX_t)$ |
|---|---|---|---|---|---|---|
| Z(t) | -1.751** | -1.473* | -1.891** | -1.360* | -1.717** | -2.592*** |
| | (0.04) | (0.07) | (0.03) | (0.09) | (0.04) | (0.006) |

# C Supplementary Appendix: Results of the Tests for Serial Correlation in the Error Term

The test is performed on the log transformed data (except for the trade-balance-to-output ratio). The models feature varying response variables and the regressors of the three commodity prices, the 3-month US Treasury bond yield, the global liquidity indicator and the VIX. The response variables are output, private consumption, public consumption, investment, the trade-balance-to-output ratio, the real, effective exchange rate and credit exposure. The test runs on unbalanced panel data. Tracing back to Wooldridge (2001), a pooled regression is applied on the first differences of the model with the fully robust standard error. It is examined to what extent the residuals are correlated. For $T > 2$, the t-statistic is made robust to arbitrary serial correlation. The results indicate serial correlation in the error term across all specifications.

## C.1 Results of the Wooldridge Test for Autocorrelation in Panel Data, Main Analysis

Table C.1: **Results of the Wooldridge test of Serial Correlation, Advanced Economies**
The table presents the results of the Wooldridge Test for Autocorrelation in Panel Data for varying dependent variables in advanced economies. $N = 26$. The Null hypothesis states no-first order autocorrelation among the residuals. The constant is omitted in the regression. p-values are shown in parentheses. p-values larger than 0.01 are rounded to two decimal places, p-values between 0.001 and 0.01 to three decimal places, p-values smaller than 0.001 are reported as $< 0.001$. *Significantly different from zero at 90% confidence, ** 95% confidence, *** 99% confidence.

| Response | $log(gdp_t)$ | $log(c_t^{pr})$ | $log(c_t^g)$ | $log(inv_t)$ | $tb_t/log(gdp_t)$ | $log(REER_t)$ | $log(cre_t)$ |
|---|---|---|---|---|---|---|---|
| F(1,25) | 2007.229*** | 2192.047*** | 214.374*** | 252.323*** | 269.949*** | 961.020*** | 255.333*** |
| | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) |

Table C.2: **Results of the Wooldridge test of Serial Correlation, Emerging Economies**
The table presents the results of the Wooldridge Test for Autocorrelation in Panel Data for varying dependent variables in emerging economies. $N = 14$. The Null hypothesis states no-first order autocorrelation among the residuals. The constant is omitted in the regression. p-values are shown in parentheses. p-values larger than 0.01 are rounded to two decimal places, p-values between 0.001 and 0.01 to three decimal places, p-values smaller than 0.001 are reported as $< 0.001$. *Significantly different from zero at 90% confidence, ** 95% confidence, *** 99% confidence.

| Response | $log(gdp_t)$ | $log(c_t^{pr})$ | $log(c_t^g)$ | $log(inv_t)$ | $tb_t/log(gdp_t)$ | $log(REER_t)$ | $log(cre_t)$ |
|---|---|---|---|---|---|---|---|
| F(1,13) | 3363.527*** | 5719.192*** | 362.093*** | 1625.093*** | 380.223*** | 139.980*** | 295.120*** |
| | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) |

Table C.3: **Results of the Wooldridge test of Serial Correlation, Commodity Exporters**
The table presents the results of the Wooldridge Test for Autocorrelation in Panel Data for varying dependent variables in commodity exporting economies. $N = 10$. The Null hypothesis states no-first order autocorrelation among the residuals. The constant is omitted in the regression. p-values are shown in parentheses. p-values larger than 0.01 are rounded to two decimal places, p-values between 0.001 and 0.01 to three decimal places, p-values smaller than 0.001 are reported as $< 0.001$. *Significantly different from zero at 90% confidence, ** 95% confidence, *** 99% confidence.

| Response | $log(gdp_t)$ | $log(c_t^{pr})$ | $log(c_t^g)$ | $log(inv_t)$ | $tb_t/log(gdp_t)$ | $log(REER_t)$ | $log(cre_t)$ |
|---|---|---|---|---|---|---|---|
| F(1,9) | 1052.887*** | 1352.135*** | 178.966*** | 536.691*** | 795.648*** | 68.350*** | 1296.872*** |
| | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) |

Table C.4: **Results of the Wooldridge test of Serial Correlation, Commodity Importers**
The table presents the results of the Wooldridge Test for Autocorrelation in Panel Data for varying dependent variables in commodity importing economies. $N = 30$. The Null hypothesis states no-first order autocorrelation among the residuals. The constant is omitted in the regression. p-values are shown in parentheses. p-values larger than 0.01 are rounded to two decimal places, p-values between 0.001 and 0.01 to three decimal places, p-values smaller than 0.001 are reported as $< 0.001$. *Significantly different from zero at 90% confidence, ** 95% confidence, *** 99% confidence.

| Response | $log(gdp_t)$ | $log(c_t^{pr})$ | $log(c_t^g)$ | $log(inv_t)$ | $tb_t/log(gdp_t)$ | $log(REER_t)$ | $log(cre_t)$ |
|---|---|---|---|---|---|---|---|
| F(1,29) | 4693.786*** | 6432.370*** | 397.605*** | 475.862*** | 301.286*** | 1079.857*** | 266.119*** |
| | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) |

# D Supplementary Appendix: Data

Supplementary data to this work can be found online at https://data.mendeley.com/datasets/5dm3j8xc5b/1.